

Three New Species of Cenocoeliinae (Hymenoptera: Braconidae) with Novel Morphological Characteristics and Habitat Records

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Abstract.—The purpose of this paper is to introduce three new Neotropical species of cenocoeliine wasps that expand the morphological and biological boundaries of the subfamily. These three species share a complex of morphological characters that distinguish them from other known species of *Capitoni*, and because of this we propose these species form a distinctive and monophyletic species group. Unlike other members of the subfamily, the new species are dorsoventrally flattened and represent some of the smallest recorded cenocoeliines. The following species are described; *Capitoni* *subcrusta* Pitz and Sharkey n. sp. from Mexico, *C. vegrandis* Pitz and Sharkey n. sp. from Costa Rica, and *C. tenuiflagellum* Pitz and Sharkey n. sp. from Colombia.

The subfamily Cenocoeliinae is relatively small with approximately 70 described species (Achterberg 1997, Braet and van Achterberg 2001, Yu et al. 2005). The few cenocoeliines with known biologies are koinobiont endoparasitoids of mostly wood-feeding coleopteran larvae, mainly in the families Cerambycidae and Curculionidae (Scolytinae) but with some host records of Buprestidae and non-scolytine Curculionidae (Saffer 1982, Shaw and Huddleston 1991). Cenocoeliines are known to parasitize hosts that utilize a variety of woody substrates, ranging from tree trunks (personal observation) to smaller branches and twigs (Shaw 1999), with scattered records from a variety of other plant material such as herbaceous stems, fruits, and nuts (Saffer 1982). Although cenocoeliines are cosmopolitan (van Achterberg 1997, Pitz and Sharkey 2005), they are most diverse in the neotropics. The subfamily has been largely overlooked in the past, leaving many new species to be described (Achterberg 1997, Ent and Shaw 1998).

Here, we describe three new species of Cenocoeliinae collected in Mexico, Costa Rica, and Colombia. These new species differ from other cenocoeliines in several ways. The mesosoma is dorsoventrally flattened (Fig. 1). The metasoma is inserted only slightly above the hind coxae (Fig. 1). The hind coxal grooves, which are ovipositor guides, are located along the anterior margin of the medial face of the hind coxae (Fig. 2d). The antennal scrobe is truncated and shallow, leaving the median ocellus outside the antennal scrobe and level with the lateral ocelli (Fig. 3a–c). The scape is swollen in the apical half (Fig. 4a). Females have short, thick antennae; the flagellomeres are about as wide as long, most having only a single row of longitudinal placodes that are nearly as long as a flagellomere (Fig. 4b). Males (Fig. 5b) have normal antennae with flagellomeres that are about twice as long as wide, each with multiple rows of placodes that range from one third to one half the length of a flagellomere. Finally, these wasps are some of the smallest members of the



Fig. 1. *Capitonius vegrandis*, holotype female.

subfamily Cenocoeliinae, with a maximum length of 3.28 mm. All of these characters are putative synapomorphies of the three newly described species. One of these remarkable species has lost the r-m crossvein of the forewing (Fig. 3g), the first report of this characteristic for the subfamily.

DISCUSSION

Collection labels of the Mexican specimens state that they were found under the bark of a tree and we suggest that the dorsoventrally flattened body is an adaptation for this habitat. Unrelated species in the genus *Chartobracon* (Braconinae) have members that are also dorsoventrally flattened (van Achterberg 1983). The type species, *Chartobracon huggerti* Achterberg, was reared from cocoons collected from cerambycid tunnels under the bark of

spruce trees (van Achterberg 1983), and other adult specimens were collected under the bark of trees (Quicke and Sharkey 1989). Species of *Chartobracon* range between 2.7–2.9 mm in body length, (van Achterberg 1983, Quicke and Sharkey 1989). These observations are consistent with the hypothesis presented here, i.e., the small flattened bodies of braconids attacking xylophagous beetles are adaptations to facilitate searching for hosts under bark.

Both the newly described species of *Capitonius* and species of *Chartobracon* have short ovipositors, ranging between 1.96–2.24 mm for the new species of *Capitonius*, and 1.2 mm for *Chartobracon* (Quicke and Sharkey 1989), such that they would not be able to penetrate far into any substrate. This suggests these species may oviposit directly into the host larvae. This is in contrast to other dorsoventrally flattened

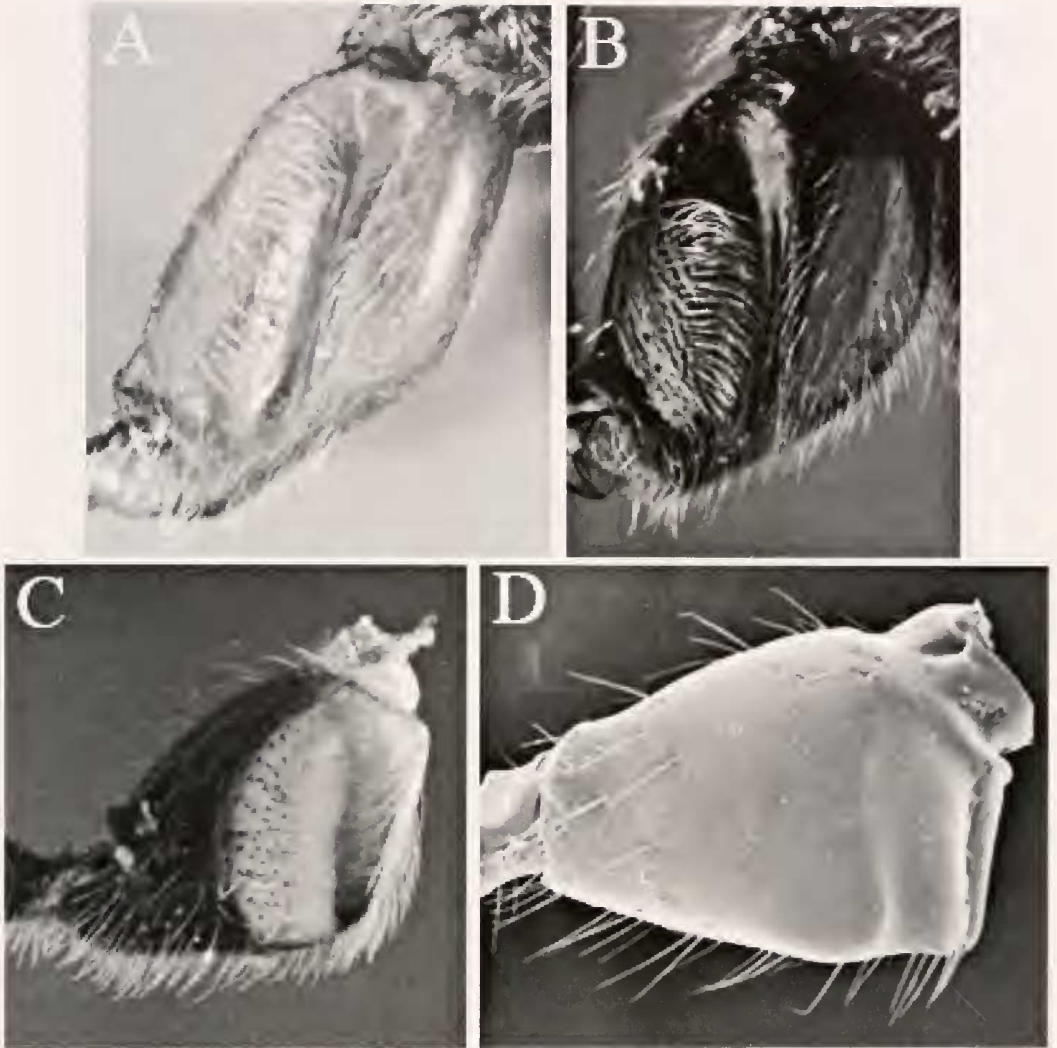


Fig. 2. Hind coxal grooves of female cenocoeliines: a, *Foenomorpha filicornis*; b, undescribed species of *Cenocoelius* from Arizona, USA; c, *Capitonius chontalensis*; d, *Capitonius subcrusta*.

species, such as those in the genus *Atanycolus* that are known to use their ovipositors to penetrate the host's substrate from the outside; these wasps are larger (over 5 mm) with longer ovipositors that allow them to penetrate into a substrate far enough to reach host larvae.

Some cenocoeliines, such as *Foenomorpha filicornis* (Cameron), have a groove on the medial surface of the hind coxa that is situated along the longitudinal axis. This directs the ovipositor posteroventrally dur-

ing oviposition (Fig. 2a). Other species, such as *Capitonius chontalensis* (Cameron), have a groove that is situated along the vertical axis of the coxa, between the midline and anterior margin that directs the ovipositor ventrally during oviposition (Fig. 2c). There are also species of Cenocoeliinae, such as an undescribed species of *Cenocoelius* from Arizona, which have an intermediate position of the hind coxal grooves angled somewhere between the previously discussed orientations (Fig. 2b).

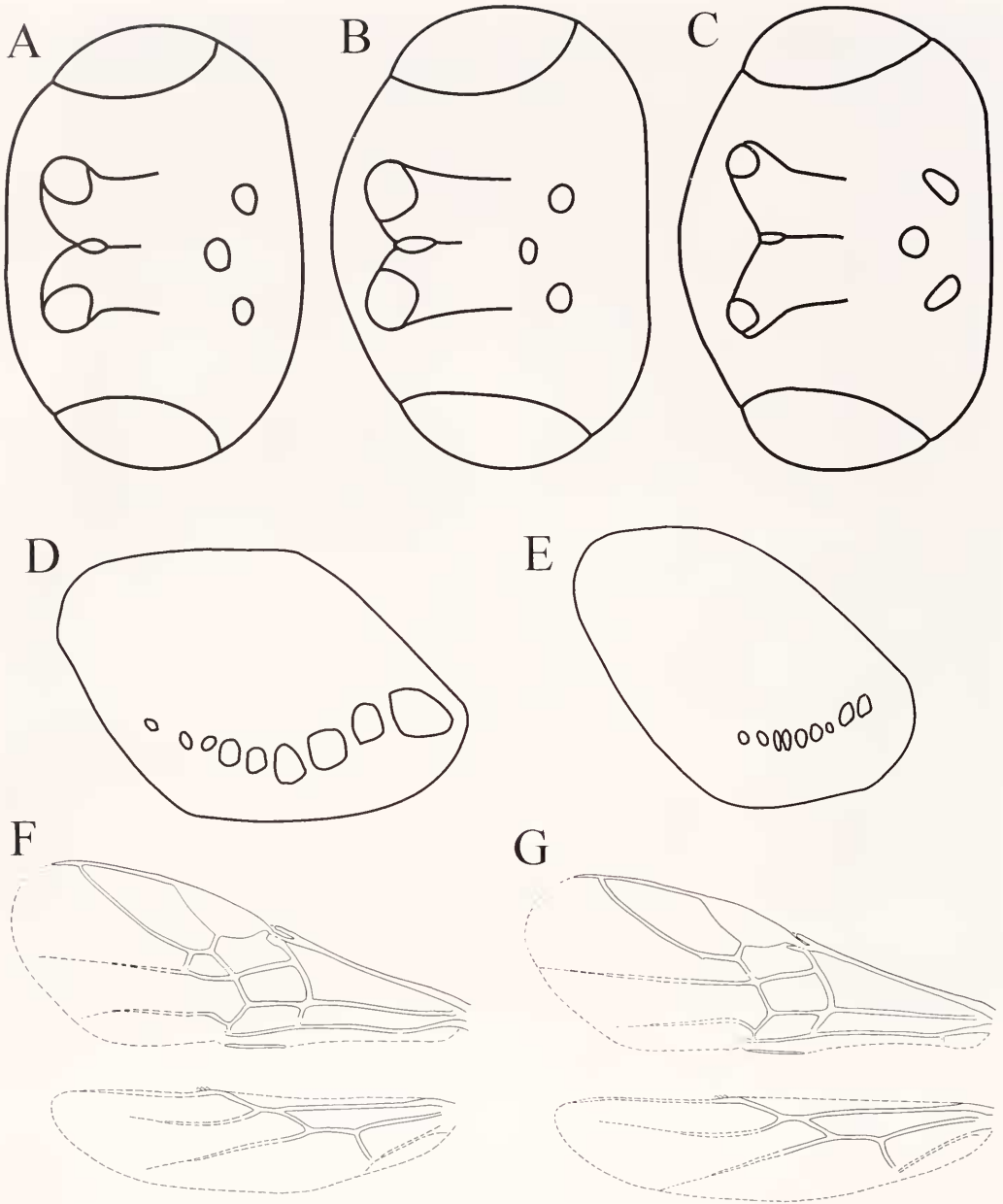


Fig. 3. Illustrations of new species of *Capitonius*: a, *C. subcrusta* dorsal head; b, *C. tenuiflagellum* dorsal head; c, *C. vegrandis* dorsal head; d, *C. tenuiflagellum* lateral mesosoma illustrating sternaulus; e, *C. subcrusta* lateral mesosoma illustrating sternaulus; f, *C. subcrusta* wings; g, *C. vegrandis* wings.

The ovipositor guides on the hind coxae of the newly proposed species are located along the anterior margin of the hind coxae and indicate that the ovipositor is directed anteroventrally during oviposition (Fig. 2d).

In most cenocoeliines, the ratio of the ovipositor to body length is proportional to the angle of the ovipositor guide, such that the longest ovipositors are found in species with guides that are almost parallel to the long axis of the coxae, and shorter ovipo-

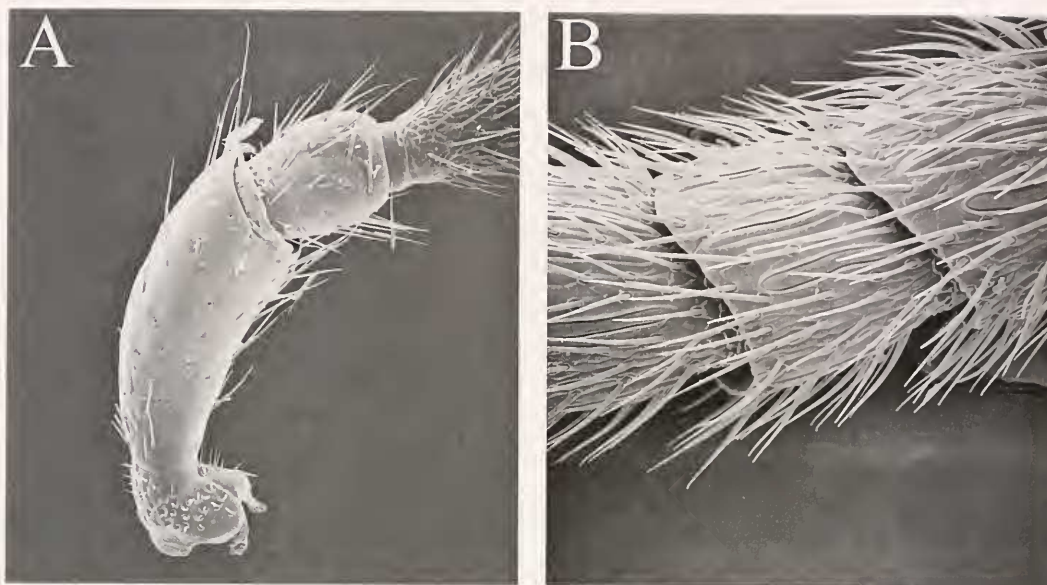


Fig. 4. *Capitonius subcrusta*: a, scape, paratype female; b, flagellomeres, paratype female.

sitors are found in species with grooves that direct the ovipositor ventrally. Examining a randomly chosen representative from the species discussed above, we found *F. filicornis* had an ovipositor: body length ratio of 1.57, the undescribed species of *Cenocoelius* from Arizona had a ratio of 1.43, and *C. chontalensis* had a ratio of 1.29, demonstrating that species with grooves that run closer to parallel to the midlength of the hind coxae tend to have longer ovipositors in relation to their body length. The newly described species have some of the shortest ovipositor: body ratios found in *Cenocoeliinae*, with ratios of 0.66, 0.73, and 0.67 for *C. tenuiflagellum*, *C. subcrusta*, and *C. vegrandis* respectively. They also have the most anteriorly located ovipositor guides of any known member of the subfamily.

Based on the microhabitat in which the Mexican specimens were collected, the orientation of the ovipositor guides, the small body size, and the short ovipositor length, we hypothesize members of the new species-group do not drill or probe into the woody substrate from the outside

of the tree, as is typical of other members of the subfamily, but crawl under the bark and directly parasitize hosts. Morphological features of the antennal scrobe also corroborate this hypothesis. The three species described here have truncated and shallow antennal scrobes, whereas all other members of the *Cenocoeliinae* have deep antennal scrobes that extend to the lateral ocelli. The antennal scrobe is a modification found in many hymenopterans that emerge from tunnels in wood. While emerging from the host substrate, the antennae are folded back and fit into the scrobe, thereby protecting them as the wasps emerge. All three new species have very shallow and truncated antennal scrobes suggesting that they have no need to protect the antennae.

Generic limits are not yet well established in the *Cenocoeliinae*, making placement of these species problematic. In the most recent treatment of the group, van Achterberg's (1994) generic concepts are based on suites of characters, and lack a phylogenetic framework. His keys and diagnoses must be used to under-



Fig. 5. *Capitonius tenuiflagellum*: a, lateral habitus , holotype female; b, lateral habitus, paratype male.

stand generic limits. Recent molecular analyses (Pitz in prep) provide a clearer understanding of relationships within Cenocoeliinae, though molecular data were not collected from these three species.

MATERIALS AND METHODS

Generic placement of the three new species is based on the results of phylogenetic analyses of cenocoeliine genera (Pitz in prep.). We tentatively assign these species to the genus *Capitonius* primarily based on the ratios of the hind wing veins M+CU to 1M; no molecular data are available for the newly described species, but their hind wing vein ratios are within the range found for other species of *Capitonius*. The specimens were compared to original descriptions and determined specimens of *Capitonius* to establish that they represent new species.

Morphological terminology used follows that of Sharkey and Wharton (1997). All photographs were taken using a JVC KY-F75 3CCD digital camera attached to a Leica MZ-16 stereoscope and were prepared using and measurements made with software in an Auto-Montage[®] imaging system. Scanning Electron Micrographs were produced using a Hitachi S-800 Field Emission Scanning Electron Microscope.

Capitonius subcrusta Species Group

Description.—Female. **Length:** 2.68–3.40 mm. **Head:** Antenna shorter than forewing, with 22 flagellomeres [on intact specimens], scape swollen apically (Fig. 4a), flagellomeres with single row of longitudinal placodes which are almost the length of the flagellomere (Fig. 4b); antennal scrobe greatly reduced, ending immediately anterior to median ocellus, carina along antennal scrobe ending before lateral ocellus (Fig. 3a–c); frons slightly convex laterally, medial lamella of antennal scrobe short; vertex smooth, with sparse, weak punctures and sparse setae laterally; area

posterior to lateral ocellus flat to slightly convex; face and clypeus smooth with sparse punctures and setae; clypeus with medioventral tooth, occipital carina smoothly rounded dorsomedially, without a sharp angle. **Mesosoma:** Dorsoventrally compressed (Figs. 1,5,6); pronotum not distinctly protruding anterodorsally, with large triangular pronope, and large triangular sub-pronope; propleuron without transverse carina; mesopleuron smooth with sparse setae; mesoscutum smooth with sparse setae, notauli narrow, composed of moderately sized rectangular fovea, nearly united immediately anterior to transscutal articulation; transscutal articulation not impressed as a groove, present as a line near midline only; scutellum without medioposterior depression; metanotum moderately crenulate; metapleuron and propodeum irregularly areolate; hind coxal groove sharply defined, situated along anterior edge of hind coxa (Fig. 2d); forefemur normal, not flanged; rectangular space between hind coxae and metasomal insertion (metasomal pseudosternite) delineated by four strong carinae; transverse groove of metapleuron at level of episternal scrobe; tarsal claws simple. **Wing:** Vein 1-M slightly curved (Fig. 3f–g); crossvein 1r-m present or absent. **Metasoma:** Second median tergite smooth; third median tergite smooth and without acute lateral margin.

Male (Fig. 5b) – as in female except for primary sexual characters and male antenna longer than forewing, with 24 flagellomeres, scape not swollen apically, flagellomeres with two to three rows of longitudinal placodes.

Diagnosis.—These species are the only known members of *Capitonius* that have the following suite of characters: body dorsoventrally flattened, antennal scrobe reduced, female with short and thick flagellomeres, female with hind coxal groove situated at extreme anterior margin of coxa. This species group has a larger suite of hypothesized synapomorphies than *Ca-*



Fig. 6. Lateral habitus, holotype female, *Capitonius subcrusta*.

pitonius itself, providing a high level of support for the proposed monophyly of *C. subcrusta*, *C. tenuiflagellum*, and *C. vegrandis*.

Distribution.—Southern Nearctic to northern Neotropical (Mexico to Colombia). Containing only three known species.

KEY TO SPECIES OF THE SUBCRUSTA GROUP

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| 1. | Second cubital cell present (Fig. 3f) | 2 |
| - | Second cubital cell absent (Fig. 3g) | <i>Capitonius vegrandis</i> Pitz and Sharkey n. sp. |
| 2. | Sternaulus complete, composed mostly of large, subvoid fovea (fig. 3d); carina bordering antennal scrobe nearly complete, ending three quarters of the way to lateral ocellus from antennal insertion (Fig. 3b)..... | <i>Capitonius tenuiflagellum</i> Pitz and Sharkey n. sp. |
| - | Sternaulus present only over posterior three-quarters of metapleuron, composed of small to moderate sized ovoid fovea (Fig. 3e); carina bordering antennal scrobe truncated, ending approximately halfway between antennal insertion and lateral ocellus (Fig. 3a) | <i>Capitonius subcrusta</i> Pitz and Sharkey n. sp. |
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Capitonus subcrusta Pitz and Sharkey
n. sp.

Etymology.—Latin for under bark; a reference to the microhabitat in which all known specimens were collected

Description.—**Holotype Female** (Fig. 6). **Length**: 2.68 mm. **Color**: Body mostly melanic except testaceous (yellowish brown) as follows: ventral margin of malar space and clypeus; mandible basally; fore- and midlegs, hind tibia basally. Wings clear with stigma melanic; ovipositor reddish brown. **Head**: Antenna with 22 flagellomeres; lateral carina bordering antennal scrobe reduced, ending far anterior to lateral ocellus (Fig. 3a); median lamella of antennal scrobe wide and slightly flattened anteriorly becoming acute posteriorly. **Mesosoma**: Pronotum with three large fovea extending from sub-pronope along posterior margin, lateral margin weakly rugose, otherwise pronotum smooth; scutellar sulcus with four fovea; propleuron smooth with moderately dense setae; sternaulus incomplete, only occupying posterior three-quarters of mesopleuron, composed of single row of fovea (Fig. 3e); space between hind coxae and metasomal insertion weakly rugose between carinae. **Wings**: Second submarginal cell present (Fig. 3f). **Metasoma**: First median tergite smooth; length 1.03 times its apical width; length of ovipositor:length of forewing ratio 0.71.

Biology.—Unknown. Specimens found under bark.

Male.—As in female except for primary sexual characters and male antenna longer than forewing, with 25 flagellomeres, scape not swollen apically, flagellomeres with two to three rows of longitudinal placodes.

Material Examined.—Holotype female: MEXICO: Tam[auli]p[a]s., Mun.[icipio] Gomez Farías, Altas Cimas, 1000 m., 8-9.III.1986, P. Kovarik, K. Haack, under bark. Deposited in Texas A&M University Collection.

Paratype male: MEXICO: MEXICO: Chipas, Lagunas de Montebello Nat[ional] Park, 11.VIII.1990 el[elevation] 5000' [1524m], J.B. Woolley. Deposited in Texas A&M University Collection.

Capitonus tenuiflagellum Pitz and
Sharkey n. sp.

Etymology.—Latin for small whip; a reference to the short antennae of the female.

Description.—**Holotype Female** (Fig. 5a). **Length**: 3.40 mm. **Color**: Body mostly melanic except testaceous (yellowish brown) as follows: head below level of antennal insertion; mandible basally; all legs except dorsal face of all tibiae, fore and mid basitarsi, hind tarsus, hind tibia basally. Wings clear with stigma melanic; ovipositor reddish brown. **Head**: [Antenna broken, 16 flagellomeres remaining on right, 11 on left]; lateral carina bordering antennal scrobe nearly complete, ending immediately anterior to lateral ocellus (Fig. 3b); median lamella of antennal scrobe acute over entire length. **Mesosoma**: Pronotum with four large fovea extending from sub-pronope along posterior margin, lateral margins weakly rugose, otherwise pronotum smooth; scutellar sulcus with four fovea; propleuron smooth with moderately dense setae; sternaulus complete, composed of single row of fovea (Fig. 3d); space between hind coxae and metasomal insertion with area between carinae rugosofoveate. **Wings**: Second submarginal cell present. **Metasoma**: First median tergite with two strong carinae basally, 1.40 times its apical width; length of ovipositor:length of forewing ratio 0.77.

Biology.—Unknown.

Male.—(Fig. 5b) – As in female except for primary sexual characters and male antenna longer than forewing, with 24 flagellomeres, scape not swollen apically, flagellomeres with two to three rows of longitudinal placodes.

Material Examined.—Holotype female: COLOMBIA, Amazonas, PNN Amacayacu, Mata-mata, 3 23'S 70 06'W, 150m, Apr [il] 02-11/

2000, M.101, A. Parente Leg., [Amazonian rainforest]. Deposited in the Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Villa de Leyva, Colombia.

Paratype male: COLOMBIA: Amazonas, PNN Amacayacu, Lorena, 3 02.86'S 69 59.7'W. 200 m., red [sweep net], 28.vii.2001, M. Sharkey & D. Campos [Amazonian rainforest]. Deposited in the Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Villa de Leyva, Colombia.

Paratype male: Amazonas, PNN Amacayacu, Matamata, 3 23'S 70 06'W, 150m., Mar[ch] 12–19.2000, A. Parente Leg., [Amazonian rainforest]. Deposited in the Hymenoptera Institute Collection, University of Kentucky, Lexington.

Capitonius vegrandis Pitz and Sharkey
n. sp.

Etymology.—Latin for tiny or diminutive, in reference to the short body length.

Description.—**Holotype Female** (Fig. 1). **Length**: 2.95 mm. **Color**: Body mostly melanic except testaceous (yellowish brown) as follows: malar space; mandible basally, foreleg except apical tarsomere; midleg except apical and basal tarsomeres; wings clear with stigma melanic; ovipositor reddish brown. **Head**: Antenna with 22 flagellomeres, lateral carina bordering antennal scrobe distinctly reduced, ending far anterior to lateral ocellus (Fig 3c); median lamella of antennal scrobe wide and blunt anteriorly, becoming narrow and acute posteriorly. **Mesosoma**: Pronotum with seven large fovea extending from subpronope to posteroventral corner, lateral margin smooth, otherwise pronotum smooth; scutellar sulcus with five fovea; propleuron smooth and bare; sternaulus complete, composed of single row of fovea (Fig 1); space between hind coxae and metasomal insertion (propodeal pseudosternite) weakly rugose between carinae. **Wings**: Second submarginal cell absent (Fig. 3g). **Metasoma**: First median tergite smooth; 1.26 times its apical width; length of ovipositor / length of forewing ratio = 0.61.

Biology.—unknown

Male.—unknown.

Material Examined.—Holotype female: COSTA RICA, Prov.[incia] Punta.[renas], La Casona, R.B., Monteverde, [10° 17' 54.3376" N 84° 47' 33.1719"W], 1520m. Abr [April] 1994. N. Obando, L, N 253250_449700 #2820. Second label: COSTA RICA INBIO CRI001781333 [with bar code]. Deposited in Instituto Nacional de Biodiversidad, Costa Rica.

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